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Estimating Crop Residue- Using Residue to Help Control Wind and Water Erosion

Elbert C. Dickey
University of Nebraska at Lincoln, edickey1@unl.edu

John Havlin
University of Nebraska-Lincoln

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The Importance of Conservation Tillage

Conservation tillage has been practiced for many years and is becoming increasingly popular with Nebraska farmers. Recent surveys show, about 8 of 19 million cropland acres in Nebraska were farmed with conservation tillage systems. Conservation tillage includes a variety of tillage and planting systems that leave at least 30 percent of the previous crop's residue on the soil surface **after** planting.

Knowing how to measure or estimate residue cover is an important facet of conservation tillage. A minimum requirement of cover on the soil surface is often specified for U.S. Department of Agriculture programs and some natural resources district's conservation tillage cost-sharing programs. Residue cover can also be an important component of a farm's overall soil and water conservation plan.

Research in Nebraska and other states shows that on fields with a 20 - 30 percent residue cover, soil erosion caused by water will be at least 50 percent less than comparable cleanly tilled fields. The greater the residue cover, the greater the erosion reduction will be. No-till systems, leaving the largest amount of residue cover, often reduce soil erosion by 90 to 95 percent. In comparison to conventional tillage methods, conservation tillage reduces erosion, saves fuel, labor, and soil moisture.

The percentage of soil surface covered with residue is important in determining how much erosion will occur from rainfall runoff. Rainfall, while essential for crop growth, dislodges soil particles from the surface, allowing them to be washed away. Crop residue shields the soil surface from raindrop impact, reducing soil particle detachment. Residue also creates "small dams" which slows the rate of runoff, allowing more time for water to infiltrate the soil. Slowing the runoff reduces the potential for soil erosion as the water flows over the surface.

Measuring Residue: Line-Transect Method

The line-transect method is a reliable and easy way to determine residue cover. The line-transect method involves stretching a 50 or 100 foot tape diagonally across the rows in a field and checking every foot to see if that "point" touches a piece of residue. When checking, a good question to keep in mind is, "if a raindrop falls at this point, will it 'hit' residue or bare soil?"

Care must be exercised to avoid overestimating. Take all readings on the same side of the tape and if there is any doubt whether a reading is a 'hit' or a 'miss', count it as a miss. The number of 'hits' counted will represent the percent of field cover with a 100 foot tape. Doubling the number of 'hits' will represent the percent of field cover with a 50 foot tape.

To make an accurate estimate, at least three measurements should be taken at sites typical of that particular field and measurements should not be taken in turn row areas.

Photo Comparison Method

Residue cover can also be estimated by comparing actual field conditions to photos of known residue cover. Photo comparison is quick but it is only an estimate and does not provide the accuracy of the line-transect method. It is important that the comparison be made when looking straight down at the residue. Scanning the field from the road is not adequate and results in overestimating the percentage of residue cover.

Percent Ground Cover in Corn Residue

30 %

50 %

70 %

Percent Ground Cover in Soybean Residue

30 %

50 %

70 %

Percent Ground Cover in Wheat Residue

30 %

50 %

70 %

Tillage Effects

The approximate percentage of residue cover remaining on the soil surface after a single pass of different tillage and planting implements is listed in Table 1. For a given implement, the actual cover percentage remaining is a result of several factors including speed, depth of operation, and the condition of both the soil and residue. The lower end of the percentage range listed corresponds to fragile residues such as soybeans, while the upper end of the range corresponds to irrigated corn residue.

Table 1. Influence of Field Operations on Surface Residue

Tillage and Planting Implements	Percent of Residue Remaining After Each Operation 1/
Moldboard Plow	3 - 5
Chisel Plow	
Straight shovel points	50 - 75
Twisted shovel points	30 - 60
Anhydrous Applicator	50 - 80
Disk (Tandem or Offset)	
3" deep	40 - 70
6" deep	30 - 60
Field Cultivator	50 - 80
Planters	
No coulter or smooth coulter	90 - 95
Narrow ripple coulter (less than 1.5" flutes)	85 - 90
Wide fluted coulter (greater than 1.5" flutes)	80 - 85
Sweeps or double disk furrowers (till-plant)	60 - 80
Drills	
Disc openers	90 - 95
Hoe openers	50 - 80
Winter Weathering	70 - 90

1/ Use lower values for fragile residue such as soybeans.

A rough estimate of the residue cover remaining after using a tillage and planting system can be obtained by multiplying the percentages together for each operation within the selected system. Corn, grain sorghum, and small grains generally will leave about 95 percent of the soil surface covered with residue following harvest, assuming the residue is uniformly spread behind the combine. However, following soybean harvest, only an 80 to 85 percent residue cover will remain.

For example, assume a tillage and planting system with three operations: (1) chisel plowing with straight points, (2) disking 6 inches deep, and (3) a planter with no coulter is used on a field of irrigated corn residue. The initial residue cover for irrigated corn is 95 percent and winter weathering losses would reduce the cover to 86 percent as shown by the following calculation:

0.95 initial x 0.90 weathering factor = 0.86 spring residue cover

Following tillage and planting the residue cover would be about 37 percent.

0.86 spring residue x 0.75 chisel x 0.60 disk x 0.95 plant = 0.37 final residue cover

Using the same tillage and planting operations in soybean residue would result in about 11 percent residue cover.

0.85 initial x 0.70 weathering x 0.50 chisel x 0.40 disk x 0.90 plant = final residue cover = 0.11

Consider this method to be a rough estimate since the variables involved prevent accurate estimates of residue cover. However, the table can be useful in planning tillage operations by offering a general idea of how much residue will remain for specific operations.

Wind Erosion/ Residue Cover

In parts of Nebraska, wind erosion can be a serious problem especially in late winter and early spring. Crop residue plays an integral role in reducing wind erosion by protecting the soil from wind contact. Standing residue provides a double benefit by reducing wind contact with the soil surface and by creating calm air pockets within the field's microenvironment allowing airborne soil particles to fall back to the surface.

Compared to flat residue, standing residue is better for reducing wind erosion even though there maybe less surface cover. Thus, residue weight can be more applicable than percent cover when evaluating potential wind erosion control. In instances where there is a need to estimate the weight of residue, information in Table 2 can provide an approximation.

Table 2. Approximate Residue Weight for Selected Covers.

Percent cover	Residue Weight, pounds/acre		
	Corn	Soybeans	Wheat
10	1000	750	250
20	1500	1500	500
30	2000	2000	750
40	3000	2500	1000
50	4500	3000	1500
60	6000	3500	2000
70	7000	4000	2500
80	8000		3000

These figures are the best estimates that can be obtained from actual measurements and published research. Residue weight research data varies considerably between sources, especially with soybeans. Factors that in-

fluence variation are amount and time of rainfall, seed variety and soil fertility.

The residue weight needed for adequate wind erosion control depends on the soil. Table 3 lists the residue weights needed for wind erosion control for common Nebraska soil textures.

The western and eastern Nebraska categories roughly represent the Sidney and Lincoln areas. The residue weights gradually decrease from Sidney eastward. The figures representing the Sidney area are for maximum wind erosion protection assuming a worst case situation of wide field widths. If wind barriers are present on fields being evaluated, the figures can be adjusted downward. Soybeans are not included in the table because they are not recommended to be grown in areas prone to wind erosion.

Potential Residue Problems

Although residue can effectively control erosion, some problems may result with increased residue levels. Reduced weed control may result from residue blocking herbicide movement into the soil and interfering with herbicide incorporation in wet soil. Heavy mulches created by crop residues retain soil moisture, keeping soil temperature cooler. These conditions may delay planting and seed germination. Heavy residue can also clog implements or otherwise hamper tillage and planting operations.

Potential problems should not be ignored by the producer. However, good management techniques can minimize many of the disadvantages associated with increased amounts of residue. Depending on the residue amount, a stalk chopping or shredding operation can minimize potential clogging problems, although this operation increases fuel and labor requirements.

Implement manufacturers are also responding to the needs of conservation tillage by designing tillage and planting implements that will perform effectively in increased residue levels.

Residue needs can be adjusted through specific structural or cropping practices. Installation of terraces can increase the effectiveness of residue cover and will minimize soil losses, especially on steeper slopes. Contour farming also assists in preventing soil losses by runoff.

Residue management, through conservation tillage, is an effective tool for reducing soil erosion but is not a cure for all erosion problems. When combined with contour farming, crop rotations, grassed waterways, stripcropping, terraces, and windbreaks, conservation tillage can be an integral part in a total conservation plan.

Table 3. Residue Weights for Wind Erosion Control.

	12" Standing Corn 50% Standing/50% Flat		Flat Corn		Standing Wheat Straw 75% Standing/25% Flat		Flat Wheat Straw	
Soil Texture	Western NE	Eastern NE	Western NE	Eastern NE	Western NE	Eastern NE	Western NE	Eastern NE
Sands	6600	4000	7600	4600	900	520	1750	900
Loamy Sands	5300	3300	6000	3800	675	380	1375	725
Fine Sandy Loam	4300	2950	5000	3400	520	360	1100	600
Clay Loam or Silty Clay Loam (More than 35% Clay)	4300	2950	5000	3400	520	360	1100	600
Silty Clay	4300	2950	5000	3400	520	360	1100	600
Loam, Silt Loam or Clay Loam (Calcareous-ph 8.4 +)	4300	2950	5000	3400	520	360	1100	600
Loam, Silt Loam (Less than 20% Clay)	3750	2700	4200	3000	415	360	875	575
Loam, Silt Loam (More than 20% Clay)	3300	2300	3800	2700	380	250	725	475
Silty Clay Loam (Less than 35% Clay)	3150	1500	3700	2200	375	200	700	325

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